FAIRCHILD SPACE AND DEFENSE SYSTEMS
A Division of Fairchild Camera and Instrument Corporation
300 Robbins Lane, Syosset, New York

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DUAL FORMAT DATA BLOCK READER

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SECTION 1

INTRODUCTION

1.1 GENERAL

This proposal has been prepared in response to a request for a Dual Format Data Block Reader. The Reader will locate and retrieve digitally coded information annotated on 70mm and 9.5 inch film, format that information, and record it on an IBM compatible magnetic tape.

1.2 BACKGROUND

FSDS has extensive experience in data annotation and retrieval systems. A pioneer in the solid state data annotation techniques, Fairchild has also built two types of data block readers that are presently in use.

The proposed reader will utilize much of the know-how acquired during the development of the previous units, and as many equivalent parts as possible.

SECTION 2

REQUIREMENTS

2.1 GENERAL CHARACTERISTICS

The Reader will be required to transport 70mm and 9.5 inch unsprocketed film at a speed of 12 inches per second, and read on the fly the data blocks specified in paragraph 2.2.

The Reader will be capable of reading operational material, either negative or positive, without the need of special processing for enhancing the data blocks, as long as these blocks conform with the specifications in paragraph 2.2 of this proposal.

The film will not be transported over stationary members of the film drive to minimize the chance of scratching the material.

Output formatting, error checking and man machine interface will be similar to those of the Fairchild Multi-Purpose Data Block Reader.

2.2 DATA BLOCK SPECIFICATION

The following specification will define the two data block formats to be read and establish a baseline for readable data.

2.2.1 Data Block Position

Figures 1 and 2 show the data block position and pitch on the 70mm and 9.5 inch formats respectively. Dimensions and tolerances were extracted by FSDS from information supplied by the Customer.

The data block's orientation is indicated by the letters A, B, C, and D, at its corners. The figures indicate that the data block orientation is equivalent in both formats but the frames of the 70mm format advance in an opposite direction to the frames of the 9.5 inch format.

2.2.2 Data Block Format

Figure 3 shows the geometry and format of the data blocks on 70mm and 9.5 inch film. The data blocks are equivalent in shape and word sizes. They are both recorded by a Fairchild FLA-610 Avalanche Luminescent Diode Array.

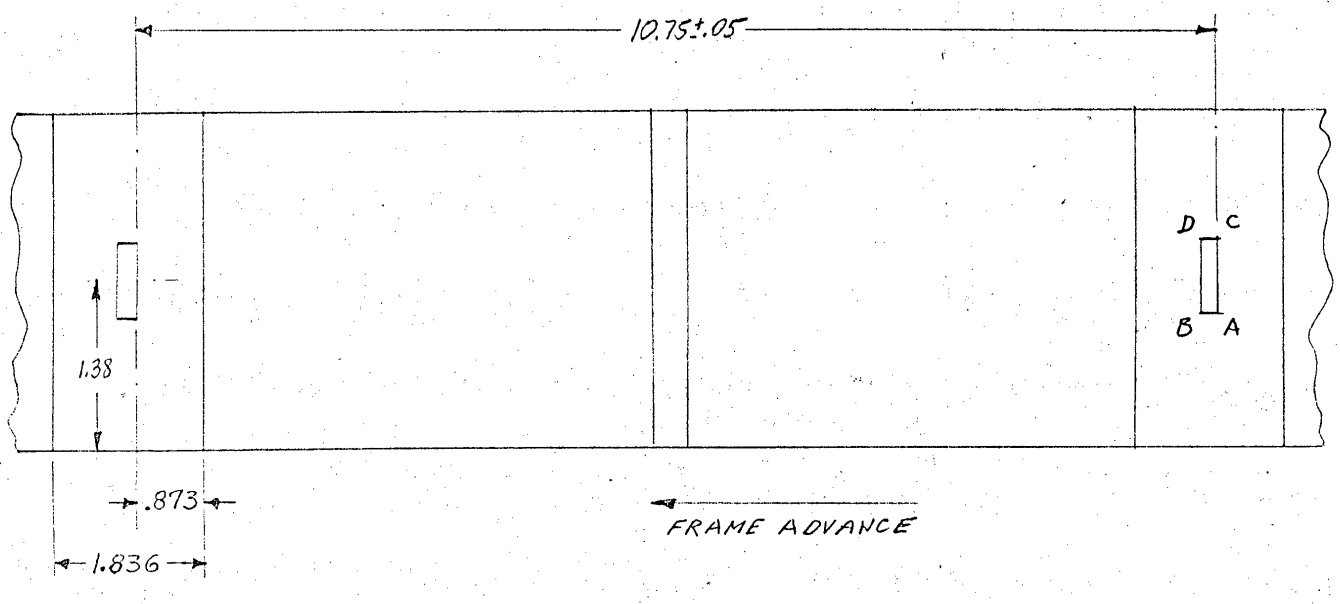

FIGURE 1 - 70MM FORMAT
EMULSION UP

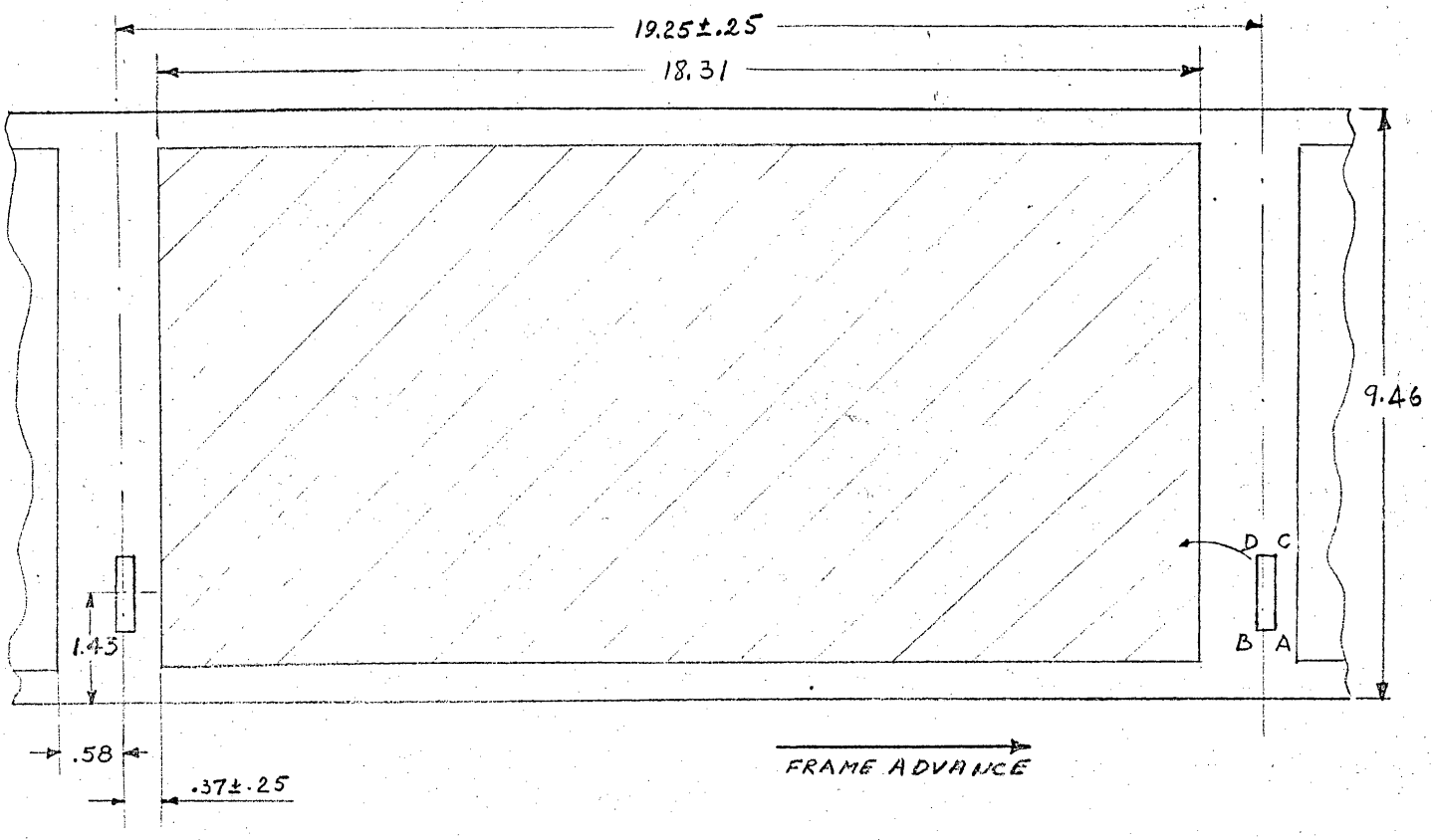

FIGURE 2 - 9½" FORMAT
EMULSION UP

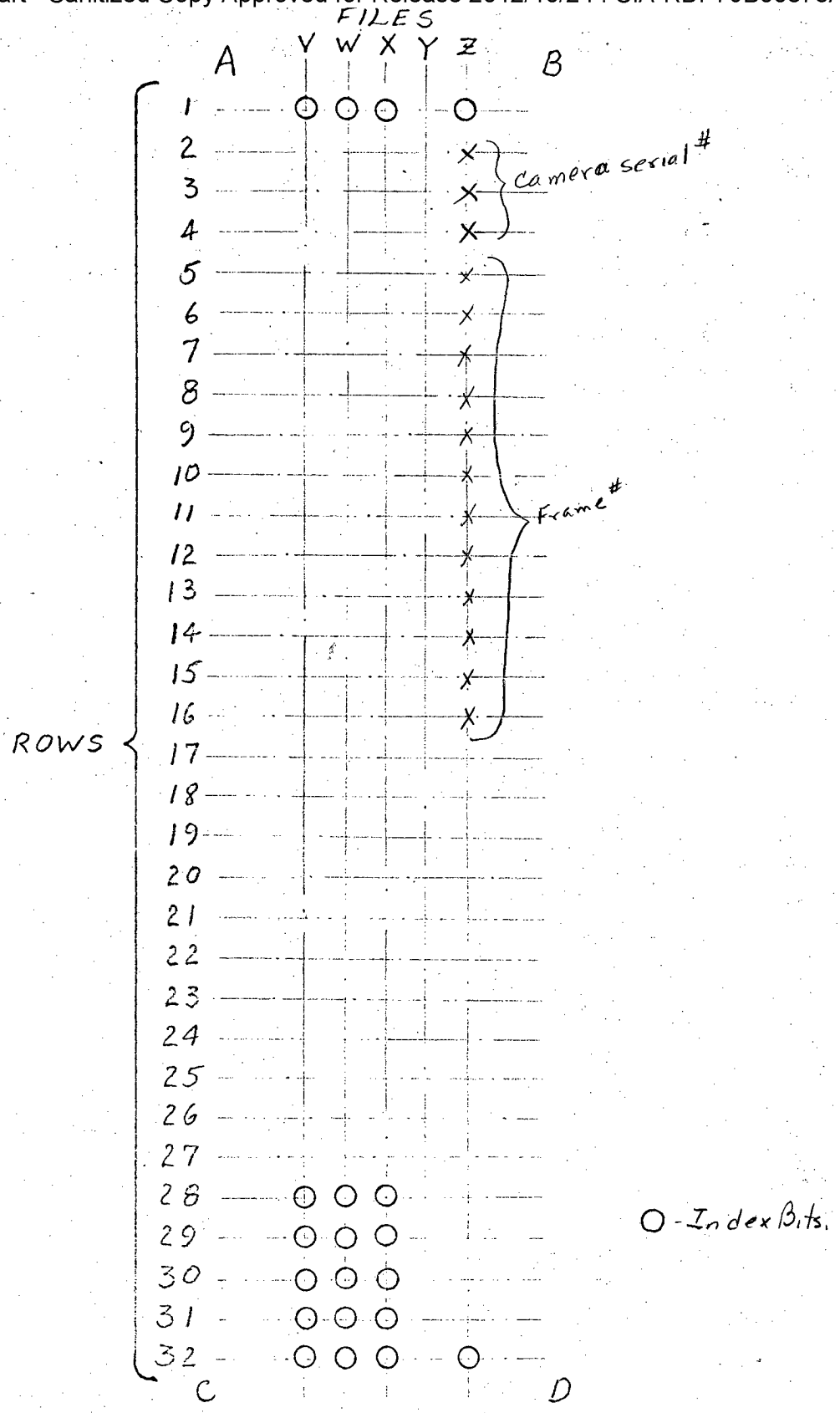

FIGURE 3
DATA BLOCK FORMAT
EMULSION UP

Each data block consists of 5 vertical files of 32 bits each. Dot and file spacing is .018 inches. Files V, W and X have index dots in row positions 1, 28, 29, 30, 31 and 32. File Z has index dots in positions 1 and 32. File Y has no index dots.

Bits 2, 3 and 4 in file Z indicate the camera serial number. Bits 5 through 16 in file Z indicate the frame number. This information can be used for data validation during the reading process.

2.2.3 Dot Density

The ratio of peak dot to background density will comply with the limits shown in Figure 10 of MIL-STD-782B, reproduced as Figure 4 of this proposal.

2.2.4 Dot Size

The readable dot size may vary from 0.006 inch minimum to 0.010 inch maximum, when measured at half density points.

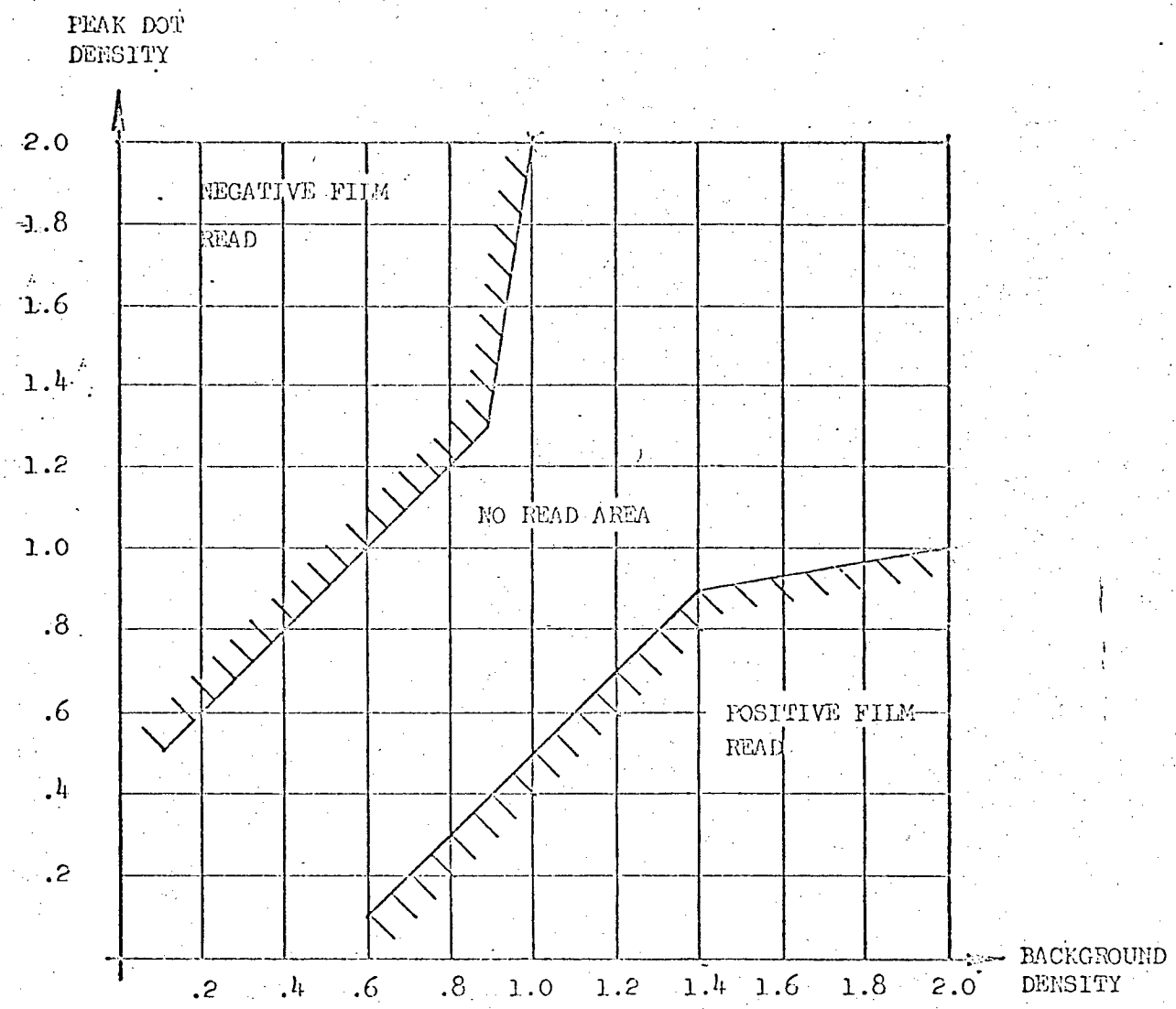

FIGURE 4

READABILITY REGION

SECTION 3

FUNCTIONAL SPECIFICATIONS

3.1 FILM SIZE

The Data Block Reader will accept 70mm or 9.5 inch film.

3.2 CAPACITY

1,000 feet maximum - each type. (500')

3.3 FILM SPEED

The film transport will be unidirectional and will carry the film at a constant velocity of 60 feet per minute. -12 "/second

3.4 DATA FORMAT

The Reader will be capable of reading the data specified in paragraph 2.2.

3.5 OUTPUT

3.5.1 Option A

The Data Block Reader will record the retrieved information on magnetic tape. The tape format shall be IBM compatible, either 7 track, 556 bits per inch, or 9 track, 556 bits, or 800 bits per inch. Number of tracks and a single tape density are to be specified in the procurement document.

Discontinued as IBM standard

Along with the tape output, a printer will generate a listing of frame numbers in which an error was detected.

The tape transport and printer will be supplied with the Reader.

3.5.2 Option B

Output will be 7 track, 556 bits per inch magnetic tape and a printer listing frames in error.

The console containing the magnetic tape drive and its electronics, as well as the printer and its electronics, will be supplied by the Customer.

3.6 ENVIRONMENT

The Data Block Reader shall be capable of operating in a laboratory environment whose temperature will be 75°F ±20°F.

3.7 POWER

The unit shall operate from a power source of 108 to 125 volts AC, 60 cycles, single phase.

SECTION 4

SYSTEM DESCRIPTION

4.1 INTRODUCTION

There are several inherent difficulties in retrieving digital data from moving film. The most severe are detection of the dots from the background, correction for film wander and dynamic skew in both camera and reader transport, and correction for magnification changes due to film flutter in the reader transport. The solutions to these problems will be discussed in the following paragraphs.

4.2 GENERAL APPROACH

Figure 5 is a general block diagram of the Dual Format Data Block Reader.

The system requires initial alignment for static skew and nominal transverse position of the data block, as well as light level adjustments for different film densities. The operator then sets the film in motion and the automatic reading begins.

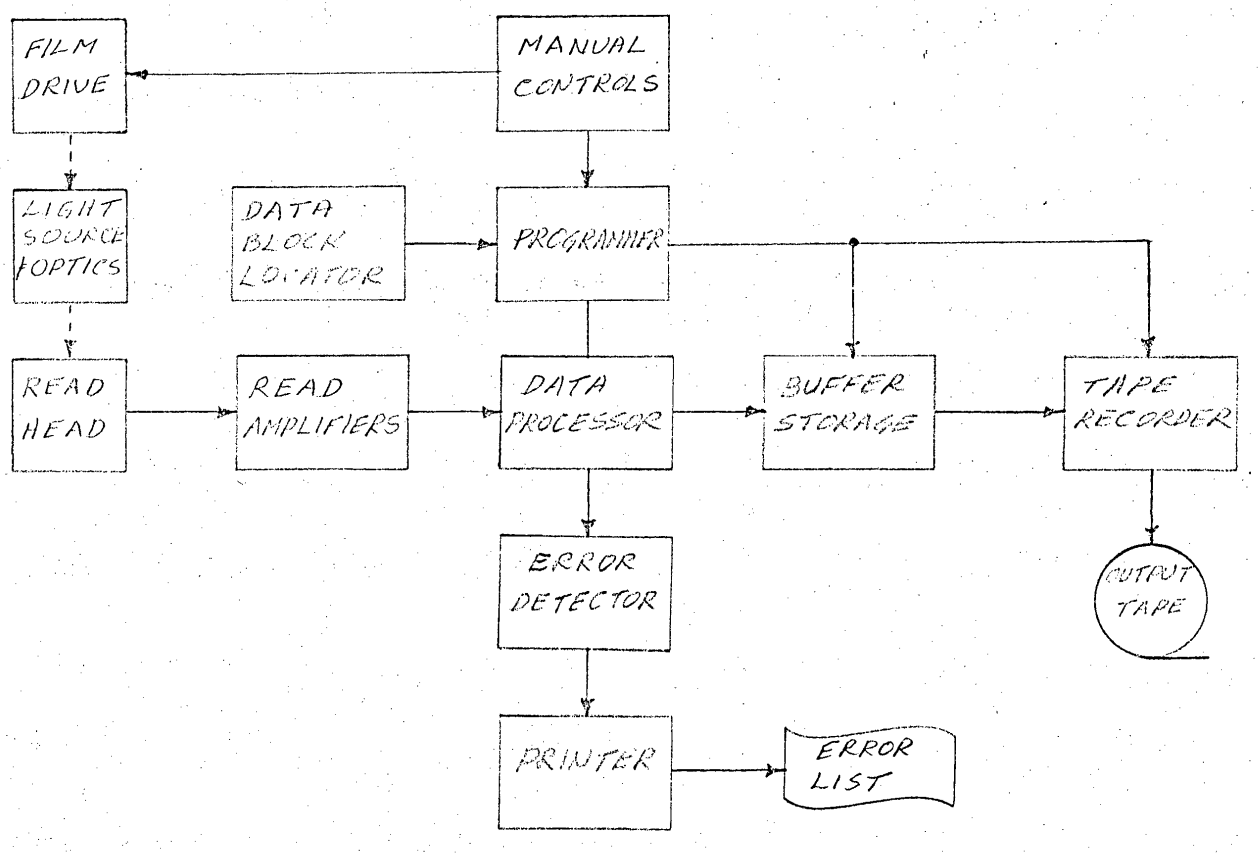

FIGURE 5- BLOCK DIAGRAM

DUAL FORMAT DATA BLOCK READER

The data block locator will meter the distance between data blocks and allow data detection only in the area between frames. The read amplifiers then detect the pattern variations on the film and forward the information to the data processor. The processor, under the control of the programmer, converts the read amplifier signals into meaningful data and presents this data to the buffer storage and the error detector. The error detector checks the validity of the data and causes the printer to print the frame numbers associated with the blocks in error. The buffer storage synchronizes the information flow between the reader and the magnetic tape recorder.

The output magnetic tape will be IBM compatible, either 7 or 9 track, dependent upon Customer preference.

Since the direction of frame advance is different in both formats and the reader transport is unidirectional, one format will be read in ascending order of frames and the other with descending order of frames. This does not cause any more work on the part of the operator. In one case he will rewind the film after the reading, and in the other, the film will be rewound before the reading.

4.3 SYSTEM COMPONENTS

4.3.1 Film Transport

The film transport will be designed to accept 70mm and 9.5 inch film up to 1,000 feet in length, and transport it at a constant speed of 60 feet per minute. The film will not contact stationary elements in its path to reduce the chance of film damage. The reading gate will be comprised of two pinch rollers spaced very closely to reduce film flutter. Also, to reduce the jitter and flutter caused by bidirectional clutches and brakes, the transport will drive the film in one direction only. Separate rewind board.

The transport will have a slack loop and guide rollers to limit film wander. The use of special spools to limit film wander may be necessary, but will be avoided if possible.

4.3.2 Light Source and Optics

The data block is illuminated by a high intensity light source concentrated through a condenser lens. The effectivity of the light source will exceed that of the previous readers, to allow reading of high density low contrast positives.

A relay lens will image the illuminated data block onto the photodiode array. The lens will be designed to retain sufficient magnification accuracy and image sharpness with film flutter of ±.005 inches from nominal.

Manual skew adjustment and edge distance setting will be provided, using a reticle and a magnifier for visual aid. These settings should not have to be made more frequently than once per each film roll.

4.3.3 Read Head

The read head will consist of an integrated silicon photodiode array. The diodes will be spaced at .006 inches apart, and the array will be long enough to cover the full length of the data block plus a maximum film wander band of .090 inches. (.072 on MFDBR)

4.3.4 Read Amplifiers

The read amplifiers will be designed to have increased sensitivity over those used in previous readers. This will allow detection of dots on low contrast positive film, where the effectiveness of the light source may be reduced by a factor of 100 due to film density.

The read amplifiers will consist of an FET preamplifier followed by an integrated circuit operational amplifier. Each photodiode output will be connected to a separate amplifier.

4.3.5 Data Block Locator

The data block locator will consist of two parts. The first is a metering device which will measure the length of film transported through the optical system. When this length will be equal to a frame length (allowing for tolerances), the second part will take over. This is an electronic recognition system in the data processor which will check for index marks in the proper locations. When both conditions are satisfied, the data block position will be considered valid, the metering system will be reinitialized to avoid accumulative errors, and data block reading will commence.

4.3.6 Data Processor

The data processor operates on the signal pattern presented to it by the read amplifiers to correct for data block wander and skew, recognize the data content, format it and present it to the buffer storage for recording.

Wander correction is accomplished by the method used in the Fairchild Multi-Purpose Data Block Reader. Each data bit is covered by three photodiodes. The programmer determines which ones of these diodes sense the dot and which sense the spaces and transfer the bit pattern to a shift register. The data is moved in the shift register until the index dot is found and then formatted and forwarded to the buffer storage. The amount of correctable wander will be increased in the Dual Format Reader from the previous .072 inches to .090 inches to facilitate possible use of standard film reels in the film transport.

The increased wander will result in a greater dynamic skew angle. The format of the data block shown in Figure 3 helps to correct the effective skew distance. Since the data block files have index dots at both extremes, each file will be split in half. Each half will be read independently, using its own wander correction circuitry, and both halves will be combined in the shift register. It is the skew distance and not the skew angle which contributes to the errors in reading. When reading a short block, reliable reading can be achieved even with a large skew angle. Therefore, by

splitting the data block into two parts, the Reader will effectively read two short blocks instead of one long block, and the effective skew distance will remain within the readability limits.

Wander and skew correction will be performed independently for each of the files of the data block, except file Y (See Figure 3), which has no index dots to lock on. The Reader will read file Y based on the correction information computed from the previous file.

After each file is read it will be formatted and forwarded to the buffer storage and the error detector.

4.3.7 Error Detector

The data block does not contain partiy bits, therefore, the only checks performed will be for format and content characteristics. The format check will insure that all index dots are detected. The content check will monitor the serial number and frame number. The serial number should remain unchanged throughout the film reel, and the frame number should increase (or decrease) by one count for each consecutive frame read.

4.3.8 Printer

The printer will print the frame number of all frames in which reading errors were detected.

If the printer is provided by the Customer, the print format and control will be equivalent to that of the Multi-Purpose Data Block Reader.

If the printer is suppled by FSDS, a different printer will be used because the model used in the Multi-Purpose Data Block Reader has been discontinued.

4.3.9 Programmer

The programmer will control the sequence and interaction of all the reader sections.

4.3.10 Buffer Storage

The buffer storage will hold the data until the tape recorder is ready to accept it in the proper format.

4.3.11 Tape Recorder

The tape recorder will record the formatted data blocks on an IBM compatible magnetic tape.

If the recorder is provided by the Customer, the format and control will be compatible with that of the Multi-Purpose Data Block Reader.

If the recorder is supplied by FSDS and uses a 7 track, 556 bits per inch recording, the model used will be the same as that in the Multi-Purpose Data Block Reader. This will facilitate interchangeability between the two readers for ease of maintenance.

If a 9 track tape recorder is used, both tape format and recorder will be different from that on the Multi-Purpose Data Block Reader.

4.3.12 Manual Controls and Display

The Reader will contain the following controls and displays:

- Power On Switch and Indicator
- Start-Stop Switch and Indicator

- Light Intensity Adjustment
- Static Skew Adjustment
- Edge Distance Adjustment
- Positive-Negative Selector
- Format Selector
- Error Indicator
- Frame Number Indicator
- Manual Tape Input, 15 Characters
- Tape Control Switches and Indicators

Change Acc Test at facility - not contractors

SECTION 5

TEST AND DELIVERY

The Dual Format Data Block Reader will be constructed to conform with best commercial practice. Acceptance tests will be performed at Fairchild Space and Defense Systems facility in Syosset, N.Y. Test procedure will be mutually agreed upon by FSDS and the Customer.

The Reader will be delivered 9 months ARO.

Don't need

The cost of maintenance manuals and detail drawings is not included in this proposal.

Test film will be supplied by the Customer.